Utah Geological Survey
a division of
Utah Department of Natural Resources

Plate 1
Utah Geological Survey Open-File Report 487
Interim Geologic Map of the Kanab Quadrangle

Contact

High angle fault

Dashed where approximately located; dotted where concealed; bar and ball on downthrown side

Strike and dip of beds

Gravel pit

Spring

Adit

A——A′
Cross section line

Unit symbol

- Qac
- Qae
- Qal1
- Qap
- Qat2
- Qat3
- Qat4
- Qes
- Qf
- Qmt
- Qmto
- Jn
- Jkt
- Jnl
- Jk
- Jks
- JTRmw
- JTRmd
- TRcp
- TRcs
- TRmu

SCALE 1:24,000
Contour Interval 40 Feet

0 1 2 4 6 Kilometers
0 0.5 1 2 3 Miles

Base from U.S.G.S. Kanab (1985) 7.5' quadrangle
Projection: UTM Zone 12
Datum: Nad 1927
Spheroid: Clarke 1866

Project Manager: Bob Biek
Cartographer: J. Buck Ehler

Interim Geologic Map of the Kanab Quadrangle, Kane County, Utah and Mohave and Coconino Counties, Arizona

by
Janice M. Hayden

2006

This geologic map was funded by the Utah Geological Survey and the U.S. Geological Survey, National Cooperative Geologic Mapping Program through USGS STATEMAP award number 05HQAG0084. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S Government.

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Description of Map Units

QUATERNARY

Alluvial deposits

Qa **Undifferentiated alluvial deposits** (Holocene to Upper Pleistocene) – Shown in cross section only as a combination of mixed alluvial and eolian, alluvial and colluvial, and alluvial-pediment deposits underneath the City of Kanab.

Qal_1 **Alluvial-stream deposits** (Holocene) – Moderately to well-sorted clay to boulder deposits in large, active drainages; mapped along Kanab Creek; includes terraces as much as 10 feet (3 m) above modern channels; 0 to 30 feet (0-9 m) thick.

Qat_2-Qat_4 **Alluvial-terrace deposits** (Holocene to Upper Pleistocene) – Moderately to well-sorted sand, silt, and pebble to boulder gravel that forms level to gently sloping surfaces above modern drainages; subscript denotes height above active drainages; level 2 deposits are about 10 to 50 feet (3-15 m), level 3 deposits are 50 to 100 feet (15-30 m), and level 4 deposits are 100 to 140 feet (30-43 m) above modern drainages; deposited primarily in stream-channel and flood-plain environments; important local source of sand and gravel; mapped north of Kanab along Kanab Creek; 0 to 50 feet (0-15 m) thick.

Qap **Alluvial-pediment deposits** (Historical to Upper Pleistocene) – Unconsolidated to weakly consolidated clay- to small boulder-size debris that forms a pediment mantle over tilted bedrock; extends into valleys along the south edge of the quadrangle from the base of the Vermilion Cliffs; upper end still receives sediment and locally includes small, poorly sorted alluvial-fan deposits, slope wash, and minor talus; dissected by and left as isolated remnants up to 60 feet (18 m) above modern drainages; lower end merges with mixed alluvial and eolian (Qae) deposits; important local source of sand and gravel; 0 to 20 feet (0-6 m) thick.

Artificial deposits

Qf **Artificial fill deposits** (Historical) – Artificial fill used to create small dams; consists of engineered fill and general borrow material; although only a few deposits have been mapped, fill should be anticipated in all built-up areas, many of which are shown on the topographic base map; 0 to 20 feet (0-6 m) thick.

Eolian deposits

Qes **Eolian-sand deposits** (Holocene) – Well- to very well sorted, very fine to medium-grained, well-rounded, mostly quartz sand derived mostly from the Navajo Sandstone; commonly deposited in irregular hummocky mounds on the lee side of ridges, primarily on the Navajo Sandstone and the more gentle slopes of the Lamb Point Tongue of the Navajo Sandstone, but also mapped on alluvial-terrace deposits where side canyons widen; 0 to 20 feet (0-6 m) thick.

Mass-movement deposits

Qmt, Qmto

Talus deposits (Historical to Upper Pleistocene) – Very poorly sorted, angular boulders with minor fine-grained interstitial sediment; deposited mostly by rock fall on and at the base of steep slopes; form primarily from blocks that weather from the Navajo and Kayenta Formations and come to rest on the more gentle slope of the Moenave Formation; locally contain small landslide and slump deposits; may include and is gradational with older, alluvial-pediment deposits (Qap) farther downslope; Qmt mantles slopes beneath cliffs and ledges, whereas Qmto mantles and armors bedrock-cored hills now isolated from nearby cliffs due to slope retreat; 0 to 20 feet (0-6 m) thick.

Mixed-environment deposits

Qac **Mixed alluvial and colluvial deposits** (Holocene) – Poorly to moderately sorted, clay- to boulder-sized, locally derived sediment; gradational with alluvial-stream (Qal_1), and mixed alluvial and eolian (Qae) deposits; deposited by fluvial, slope-wash, and creep processes in swales, minor active drainages, and behind small dams created by artificial fill; 0 to 30 feet (0-9 m) thick.

Qae **Mixed alluvial and eolian deposits** (Historical to Upper Pleistocene) – Moderately to well-sorted, clay- to sand-sized alluvial sediment that locally includes abundant eolian sand and minor alluvial gravel; exhibits stage II pedogenic carbonate development (Birkeland and others, 1991); to the east of the quadrangle at Park Wash and Kitchen Corral Wash, radiocarbon dates from similar deposits indicate six depositional phases beginning at 6320, 5650, 5390, 4330, 2145, and 340 years before present (Sable and Hereford, 2004); upper reaches near Vermilion Cliffs still receive sediment; includes alluvial fans deposits too small to map separately in the upper part; mapped in the southeast corner of the quadrangle beneath the City of Kanab and in the northwest corner of the quadrangle on a broad, nearly flat area of the Navajo Sandstone; 0 to 50 feet (0-15 m) thick.

unconformity

JURASSIC

Navajo Sandstone

Jn **Main body** (Lower Jurassic) – Light-gray to pale-orange and moderate-reddish-orange to moderate-reddish-brown, massively cross-bedded, moderately well-cemented, well-rounded, fine- to medium-grained, frosted quartz sandstone; strongly jointed; forms the White Cliffs step of the Grand Staircase (Gregory, 1950); locally contains contorted beds; springs develop at lower contact with the Tenny Canyon Tongue of the Kayenta Formation; deposited in a vast coastal and inland dune field with prevailing winds principally from the north, with rare interdunal ephemeral lakes (Blakey, 1994, Peterson, 1994); lower contact is drawn where the massively bedded, vertically jointed sandstone gives way to the thinner bedded siltstone and sandstone of the Tenny Canyon Tongue of the Kayenta Formation; map unit includes areas of weathered sandstone

regolith and Quaternary eolian sand too small to map separately; only lower 500 feet (150 m) is present in the quadrangle, but total thickness in this area is 1800 to 2000 feet (550-610 m) (Sargent and Philpott, 1987).

Jkt **Tenny Canyon Tongue of Kayenta Formation** (Lower Jurassic) – Interbedded pale-reddish-brown siltstone, mudstone, and very fine grained, very thin bedded to laminated, quartz sandstone; deposited in a fluvial environment (Tuesink, 1989); conformably lies between the main body and the Lamb Point Tongue of the Navajo Sandstone with sharp upper and lower contacts; slope former; lower contact is placed where the thin, interbedded siltstone, mudstone, and sandstone above give way to the massively cross-bedded sandstone of the Lamb Point Tongue of the Navajo Sandstone; thickens westward from 150 to 200 feet (45-60 m).

Jnl **Lamb Point Tongue** (Lower Jurassic) – Grayish-white to grayish-orange, very fine to fine-grained, massively cross-bedded, quartz sandstone; conformably lies between Tenny Canyon Tongue and main body of the Kayenta Formation; forms cliffs; springs develop at the lower contact with the main body of the Kayenta Formation; lower contact is placed where the massively bedded, vertically jointed sandstone gives way to thinner bedded siltstone and sandstone; deposited in an eolian erg and sabkha environment (Tuesink,1989); thickens eastward across the quadrangle from 350 to 450 feet (105-135 m).

Jk **Main body of Kayenta Formation** (Lower Jurassic) – Reddish-brown to moderate-reddish-brown to pale-red siltstone and mudstone interbedded with very fine to fine-grained sandstone; includes minor intraformational pebble conglomerate and thin beds of light-gray limestone; light-gray siltstone marker bed about 30 feet (9 m) below the top extends across the quadrangle; deposited in distal river, distal fluvial/playa, and minor lacustrine environments (Tuesink, 1989; Sansom, 1992; Blakey, 1994; Peterson, 1994); forms ledgy slopes; thickness varies from 250 to 350 feet (75-105 m).

Jks **Springdale Sandstone Member of Kayenta Formation** (Lower Jurassic) – Marzolf (1994) and Blakey (1994) proposed a major regional unconformity at the base of the Springdale Sandstone Member of the Moenave Formation and suggested that the member is conformable with the Kayenta Formation. Subsequent work by Lucas and Heckert, 2001; Molina-Garza and others, 2003; and Steiner, 2005 also suggests that the Springdale Sandstone is more closely related to, and should be made the basal member of, the Kayenta Formation. As a result, the Springdale Sandstone is herein informally reassigned as the basal member of the Kayenta Formation.

Mostly pale-reddish-purple to pale-reddish-brown, moderately sorted, fine- to medium-grained, medium- to very thick bedded sandstone, and minor, thin, discontinuous lenses of intraformational conglomerate and thin interbeds of moderate-reddish-brown or greenish-gray mudstone and siltstone; has large lenticular and wedge-shaped, low-angle, medium-to large-scale cross-bedding; secondary color banding that varies from concordant to discordant to cross-beds is common in the sandstone; weathers to rounded cliffs in the west half of the quadrangle and to more angular ledges in the east

half; unconformable lower contact with the Whitmore Point Member of the Moenave Formation is placed at the base of the more massive, ledgy sandstone beds above the slope of interbedded mudstone and claystone; contains locally abundant petrified and carbonized fossil plant remains; deposited in braided-stream and minor flood-plain environments (DeCourten, 1998); generally thickens eastward but locally thickens and thins abruptly; from 100 to 250 feet (30-75 m) thick.

unconformity, J-sub Kayenta (Blakey, 1994)

JURASSIC/TRIASSIC
Moenave Formation

JTRmw **Whitmore Point Member** (Lower Jurassic) – Interbedded, pale-reddish-brown, greenish-gray, and grayish-red mudstone and claystone, with thin-bedded, moderate-reddish-brown, very fine to fine-grained sandstone and siltstone; siltstone is commonly thin bedded to laminated in lenticular or wedge-shaped beds; claystone is generally flat bedded; contains several 2- to 6-inch-thick (5-15 cm), bioturbated, cherty, very light gray to yellowish-gray dolomitic limestone beds with algal structures, some altered to jasper, and fossil fish scales of *Semionotus kanabensis*; forms poorly exposed ledgy slopes; moving eastward across the quadrangle, the percent of red beds increases and contact is increasingly difficult to pick; lower, conformable contact is placed at a pronounced break in slope at the base of the lowest light-gray, thin-bedded, dolomitic limestone and above the thicker bedded sandstone and siltstone ledges of the Dinosaur Canyon Member; deposited in low-energy lacustrine and fluvial environments (DeCourten, 1998); thickens to the west from 40 to 60 feet (12-18 m).

JTRmd **Dinosaur Canyon Member** (Lower Jurassic to Upper Triassic) – Uniformly colored, interbedded, generally thin-bedded, moderate-reddish-brown to moderate-reddish-orange, very fine to fine-grained sandstone, very fine grained silty sandstone, and lesser siltstone and mudstone; ripple marks and mud cracks common; forms ledgy slope that steepens eastward; forms the base of Vermilion Cliffs step of the Grand Staircase (Gregory, 1950); unconformable lower contact is placed at the prominent color and lithology change from reddish-brown siltstone above to pale-greenish-gray shale of the Petrified Forest Member of the Chinle Formation below; deposited on broad, low flood plain that was locally shallowly flooded by water (fluvial mud flat) (DeCourten, 1998); thickness varies from 150 to 250 feet (45-75 m).

unconformity J-0 of Pipiringos and O'Sullivan (1978); however, the Jurassic-Triassic boundary is now considered to be in the Dinosaur Canyon Member of the Moenave Formation (Molina-Garza and others, 2003; Lucas and others, 2005).

TRIASSIC
Chinle Formation

TRcp **Petrified Forest Member** (Upper Triassic) – Highly variegated, light-brownish-gray, pale-greenish-gray, to grayish-purple bentonitic shale, mudstone, siltstone, and claystone, with lesser thick-bedded, resistant sandstone and pebble to small cobble

conglomerate near base; clasts are primarily chert and quartzite; contains minor chert, nodular limestone, and very thin coal seams and lenses up to 0.5 inch (1 cm) thick; mudstone weathers to a “popcorn” surface due to expansive clays and causes road and building foundation problems; contains locally abundant, brightly colored fossilized wood; weathers to badland topography; prone to landsliding along steep hillsides, however, outcrops within this quadrangle have low relief; mostly slope forming; lower contact with the Shinarump Conglomerate Member of the Chinle Formation is placed at the base of the purplish-gray clay slope and above the prominent sandstone ledge; deposited in lacustrine, flood-plain, and braided-stream environments (Dubiel, 1994); not completely exposed within the quadrangle; underlies the the City of Kanab and Quaternary alluvial-pediment and mixed alluvial-eolian and alluvial-colluvial deposits in the valley along the south edge of the quadrangle; thickness is 700 to 800 feet (210-240 m).

TRcs **Shinarump Conglomerate Member** (Upper Triassic) – Varies from dark-brown to moderate-yellowish-brown, medium- to coarse-grained sandstone with locally well-developed limonite bands (“picture rock” or “landscape stone”) to a moderate-brown, pebbly conglomerate with subrounded clasts of quartz, quartzite, and chert; mostly thick- to very thick bedded with both planar and low-angle cross-stratification, although thin, platy beds with ripple cross-stratification occur locally; strongly jointed with common slickensides; contains poorly preserved petrified wood that is commonly replaced in part by iron-manganese oxides; forms a resistant ledge to small cliff above the Moenkopi Formation, thus capping the Chocolate Cliffs step of the Grand Staircase (Gregory, 1950); lower unconformable contact is drawn at the base of the small cliff, above the slope-forming reddish-brown siltstone of the upper red member of the Moenkopi Formation; variable in composition and thickness because it represents stream-channel deposition over Late Triassic paleotopography (Dubiel, 1994); only exposed in the southeast corner of the quadrangle; thickness is 45 to 55 feet (14-17 m).

unconformity (TR-3) (Pipiringos and O’Sullivan, 1978)

Moenkopi Formation

TRmu **Upper red member** (Middle? and Lower Triassic) – Interbedded moderate-reddish-brown, thin-bedded siltstone and mudstone and moderate-reddish-orange, thin- to medium-bedded sandstone with planar, low-angle, and ripple cross-stratification; contains some thin gypsum beds and abundant discordant gypsum stringers; well-preserved ripple marks common in the siltstone; forms ledgy slope and cliffs; overall, generally coarsens upward; deposited in coastal-plain and tidal-flat environments (Dubiel, 1994); only upper 30 feet (9 m) is exposed in the southeast corner of the quadrangle; complete thickness in the area is about 100 to 160 feet (30-50 m) (Doelling and Davis, 1989).

Subsurface Unit

MzPzu Mesozoic-Paleozoic, undivided – shown on cross section only.

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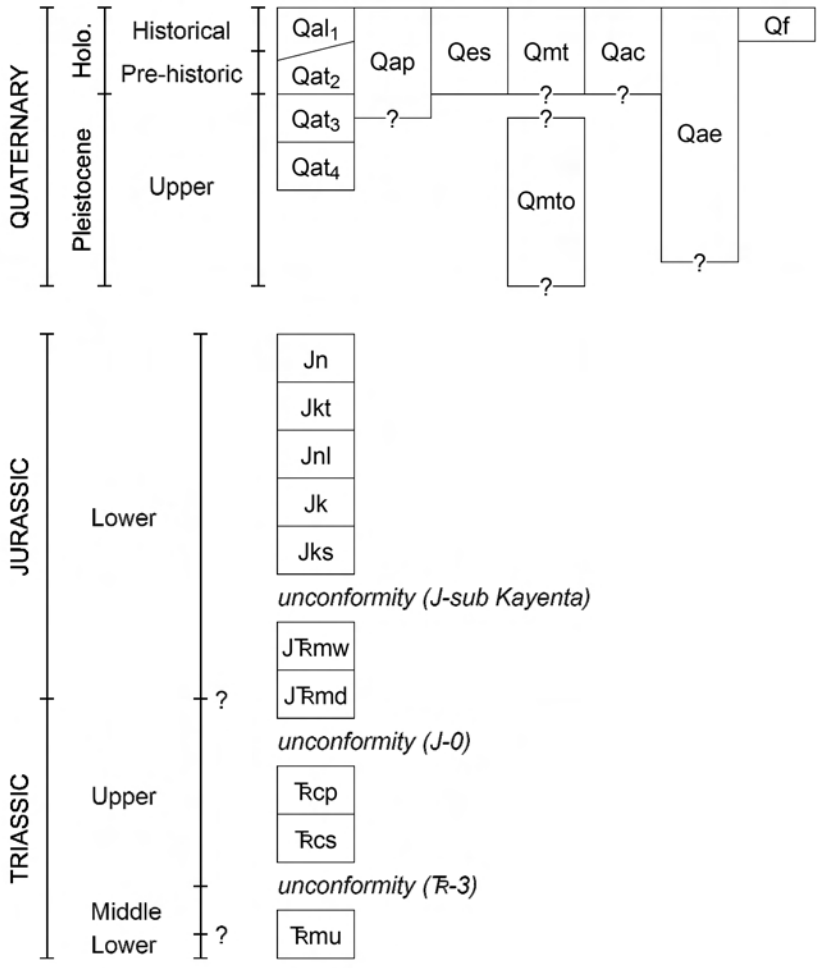
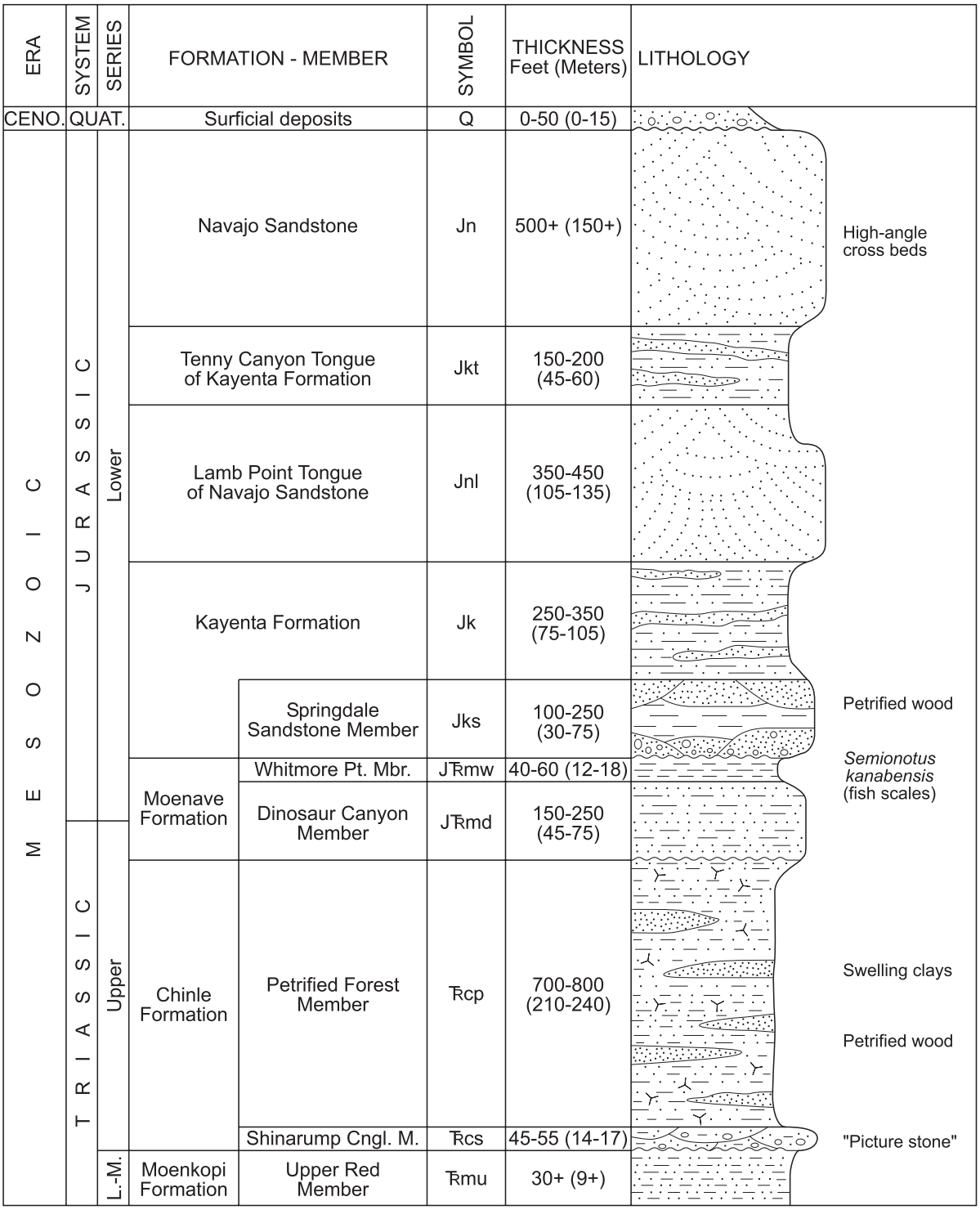
CORRELATION OF GEOLOGIC UNITS

Kanab 7.5' Quadrangle

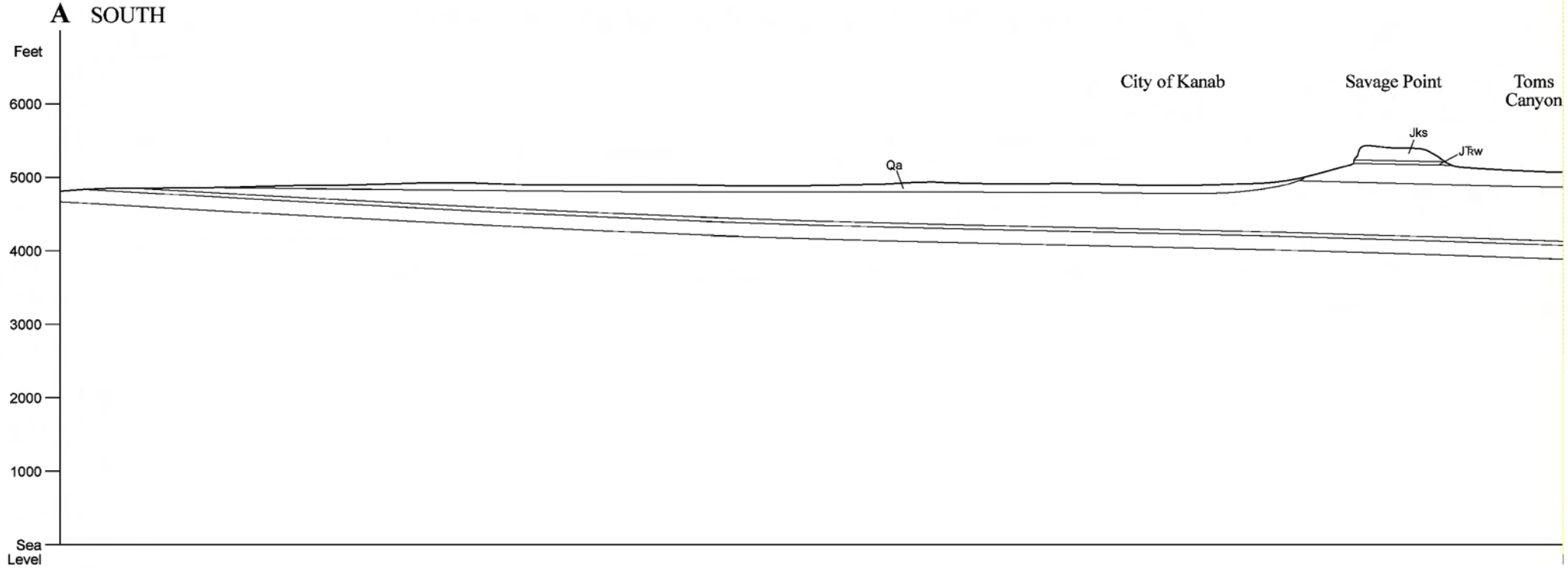


STRATIGRAPHIC COLUMN

Kanab 7.5' Quadrangle



KANAB 7.5' QUADRANGLE CROSS SECTION



KANAB 7.5' QUADRANGLE CROSS SECTION